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Walk on the wild side: the complexity of free-living mobility assessment

Aodhán Hickey[1], Sam Stuart[2], Karol O'Donovan[3], Alan Godfrey[4]

[1]Insight Centre for Data Analytics, University College Dublin, Dublin, Ireland
[2]On Medical Limited, Newcastle upon Tyne, UK
[3]School of Medicine, University College Cork, Cork, Ireland
[4]Newcastle University Business School, Newcastle University, Newcastle upon Tyne, UK

Correspondence to:
Dr Alan Godfrey,
Newcastle University Business School,
5 Barrack Road,
Newcastle University,
Newcastle on Tyne
NE1 4SE, UK;
alan.godfrey@ncl.ac.uk

Twitter
Follow Dr Alan Godfrey at @godfreybiomed

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Letter

A recent study quantified free-living (community) mobility using subjective questionnaires.[1] The authors found no useful information from their free-living mobility data. This can be attributed to the limited methodology, more likely overcome with standardised objective approaches.

Are inertial sensor-based (accelerometer/gyroscope) wearables the viable solution? They promise the next step in monitoring: unobtrusive, objective, continuous and pervasive. However, lack of clinically appropriate (sensitive/specific) algorithms has hindered advances. Often, attempts to instrument mobility in the context of physical activity (energy expenditure) or ambulation ('macro gait': walking bout detection or step count) have used invalid devices, but nevertheless used to inform pathological diagnosis. Yet, robust free-living validation studies are severely lacking. Moreover, we have yet to witness the integration of these devices into existing information technology infrastructures. True value may be found by standardising algorithms, establishing gold standard approaches and integration into wider technologies.

Additionally, instrumentation of mobility tasks are difficult to regulate due to the range of technologies and algorithms for ageing/pathological sensitive tasks (ie, gait). For example, utility is found in Parkinson's disease (PD) due to the deterioration of macro and micro (spatiotemporal) gait.[2] Of notable engineering and clinical utility is the pragmatic use of a single device worn on the lower back: reducing analytical computation, minimal patient burden and holistic gait

capture.[3] However, approaches to PD gait quantification differ during supervised and free-living assessment.[2] Without a suitable 'gold standard' approach researchers are left with a variety of methods as there is no theoretical basis to define gait quantification by wearables, impacting application to other pathologies.

Free-living gait is a complex process to interpret: data must be deciphered to provide specific/discrete information on gait (up/down stairs, etc), turning, stumble/trip or falls. Complexity is also exacerbated by cognitive loading and effect of habitual environments. To overcome complexity, studies have focused on prolonged bout identification (≥10/60 seconds ≈ 20/120 steps).[4] Yet, quantifying gait at a higher resolution (<10 steps) is important due to the abundance (~90%) accumulated in that range,[2] providing greater insight into mobility performance.

Researchers aiming to assess free-living mobility (macro gait) must appreciate its complexity. Long purposeful bouts (eg, outdoor mobility) occur in ~20% of observed time. In contrast, mobility that manifests as short/moderate gait bouts (eg, household activities) occurs most often.[5] However, the complexity, as a function of task and environment, make it difficult for successful identification by wearables. Implementing robust and contextually valid algorithms derived from theoretical, standardised methodologies can progress research.

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